CARL BLAKE

# DETAILED OPERATING PLAN

# FOR COLUMBIA RIVER TREATY STORAGE

# 1 JULY 1973 THROUGH 31 JULY 1974

14 September 1973

September 14, 1973

# DETAILED OPERATING PLAN FOR COLUMBIA RIVER TREATY STORAGE 1 JULY 1973 THROUGH 31 JULY 1974

## 1. REFERENCES AND INTERPRETATION

In this document

(a) "Principles and Procedures" means the document "Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage", dated 25 July 1967;

(b) "Assured Operating Plan" means the document "Columbia River Treaty Hydroelectric Operating Plans for Canadian Storage, Operating Years 1969-70 through 1974-75", dated 15 February 1969;

(c) "Flood Control Plan" means the document "Columbia River Treaty Flood Control Operating Plan", October 1972;

(d) "Operating Year" means the period from 1 July 1973 through 31 July 1974;

(e) "Operating Committee" means the Columbia River Treaty Operating Committee;

(f) "Detailed Operating Plan" means a detailed operating plan prepared for the Operating Year by the Operating Committee pursuant to the Principles and Procedures and consisting of the contents of this document;

(g) "Program for Initial Filling of Mica Reservoir" means the document of that title dated 26 July 1967, as amended;

(h) "Runoff Volume Forecast Program for Canadian Columbia River Treaty Reservoirs" means the document of that title dated 15 August 1969, with subsequent modifications as agreed by the Operating Committee.

## 2. PREPARATION AND SCOPE

This Detailed Operating Plan has been developed from the Assured Operating Plan for the 1973-74 Operating Year. System load and resource estimates, duration of critical period, flood control and other criteria have been reviewed and revised in accordance with Section 16 of the Principles and Procedures as necessary. A revised Critical Period System Regulation was developed to reflect current load estimates and resource schedules including operations required for construction purposes at Libby, Dworshak and Grand Coulee projects. The Critical Period System Regulation was based on historical streamflows for the 20½-month period extending from 16 August 1973 through 30 April 1975 with 1943-45 hydro conditions. In this regulation the pattern of usable storage draft from full content to empty for each reservoir except Mica was established as its Critical Rule Curve. The second critical rule curve for 1974-75, Exhibit 3, shows 129,000 second-foot-days of usable storage remaining in Mica on April 30, 1975. This usable storage is transferred to Mica dead storage in accordance with the agreement between B. C. Hydro and Bonneville Power Administration for use of additional Arrow storage in 1972-73. The data, criteria and procedures presented herein will be used as described for the formulation and

use of Operating Rule Curves for each of the Canadian storage reservoirs, Duncan, Arrow and Mica, and for the whole of the Canadian storage.

The usable Canadian storage space available for power purposes during the Operating Year is 15.5 million acre-feet distributed as follows:

Duncan Reservoir

1.4 million acre-feet (705.8 thousand second-foot-days) between elevations 1892.0 feet and 1794.2 feet measured at Duncan forebay. (Based on B. C. Hydro table dated 21 February 1973.)

Arrow Reservoir

7.1 million acre-feet (3579.6 thousand second-foot-days) between elevations 1443.5 feet and 1378.0 feet, measured at Fauquier, B.C. (Based on B. C. Hydro table dated 21 February 1973.)

Mica Reservoir

7.0 million acre-feet (3529.2 thousand second-foot-days) measured at Mica forebay. (Based on Mica storage table dated 20 February 1967.) Any storage filled in excess of 7.0 million acre-feet will be allocated in accordance with the Program for Initial Filling of Mica Reservoir.

The usable Canadian storage available for normal flood control purposes for the Operating Year is 1.27 million acre-feet in Duncan Reservoir below elevation 1892.0 feet and 5.0 million acre-feet in Arrow Reservoir below elevation 1443.5 feet and 2.08 million acre-feet in Mica Reservoir except that additional storage may also be operated for flood control purposes under special circumstances, as described in the Flood Control Plan. The foregoing assumes a 2.0 million acre-feet transfer of flood control storage from Arrow Reservoir to Mica Reservoir as detailed in the Flood Control Plan.

4. OPERATING RULE CURVE

The Operating Rule Curve for each of the Duncan, Arrow and Mica Reservoirs and for the whole of Canadian storage during the period 1 July 1973 through 31 July 1974, to be determined in accordance with the reference documents of Section 1, is defined as follows:

a. During 1 July 1973 through 31 December 1973, it is the higher of the Critical Rule Curve and the Assured Refill Curve.

b. During 1 January 1974 through 31 March 1974, it is the lower of the Variable Refill Curve and the Assured Refill Curve. The Assured Refill Curve shall be no lower than the first year Critical Rule Curve. In no case shall the Operating Rule Curve be lower than the Critical Rule Curve for 1974-75.

c. During 1 April 1974 through 31 July 1974, it is the lower of the Assured Refill Curve and the Flood Control Refill Curve.

d. The upper limit for the Operating Rule Curve shall be the higher of the Flood Control Storage Reservation Curve and the Variable Refill Curve.

5. OPERATION

The operation of Treaty storage by the Columbia River Treaty Operating Committee during the period 1 July 1973 through 31 July 1974 will be in accordance with the reference documents of Section 1, and the following operating guides:

| | | |
|---|---|---|
| a. | First Critical Rule Curve and Assured Refill Curve for Duncan, Arrow and Mica and the whole of Canadian storage for 1973-74. | Exhibit 1 |
| b. | Second Critical Rule Curve for Duncan, Arrow and Mica and the whole of Canadian Storage for 1973-74. | Exhibit 2 |
| c. | Second Critical Rule Curve for 1974-75, for Duncan Arrow and Mica and the whole of Canadian storage. | Exhibit 3 |
| d. | 1973-74 Flood Control Refill Curve and Variable Refill Curve Procedures. | Exhibit 4 |

Libby project will be available for normal operation from 1 July 1973 to 31 July 1974, with the exception of the requirement that the reservoir must be held at or below elevation 2390 feet from 15 December 1973 to 1 April 1974. This requirement is necessary for construction of the selective withdrawal structure.

6. SCHEDULING STORAGE REGULATION

a. The Operating Committee will exchange all current operating data necessary to the regulation of Canadian storage projects.

b. Seasonal runoff volume forecasts for Canadian Treaty Projects shall be made available by the Canadian Section no later than the seventh of each month, as required. Forecasts of seasonal runoff volume at periods other than those representing month-end conditions may be requested by the Operating Committee if hydrologic conditions warrant. Seasonal runoff volume forecasts for the Columbia River at The Dalles, Oregon, shall be made available by the U.S. Section on the second working day of each month as required.

c. Unless otherwise agreed, requests by the U.S. Section of the Operating Committee for the regulation of the Canadian Storage content will be made to the Canadian Section of the Operating Committee on a regular basis in accordance with the following procedures:

(1) Weekly Requests for Storage Regulation During the Storage Drawdown Season

(a) Timing of Requests. A preliminary request will be made not later than noon each Thursday, followed by a final request by noon Friday, if necessary.

(b) Confirmation of Requests. Written confirmation of the request will be dispatched on Friday in accordance with the following format unless otherwise agreed: This message will confirm our verbal request of this date for the (storing/drafting) of _____ ksfd (in/from) the whole of Canadian storage for the period ____ through ____. This request is based on an estimated average regulated inflow of ____ kcfs to Arrow Reservoir, ___ kcfs to Duncan Reservoir, ____ kcfs to Mica Reservoir, and ____ kcfs to Libby Reservoir during the above mentioned period, and an average discharge of ____ kcfs from the Arrow Project, ____ kcfs from the Duncan Project, ____ kcfs from the Mica Project and ____ kcfs from the Libby Project.

(c) Period Covered by Request. The period covered by the request shall be from 0800 hours on the Sunday following the date of the weekly request to 0800 hours on the Sunday a week later.

(d) Release Determinations. The amount of water released or stored during the period of the request will be determined by the changes in reservoir elevation at Duncan, Arrow and Mica. The change in Arrow storage content will be determined using the gauge near Fauquier, B.C., for the Lower Arrow Lake and using the gauge near Nakusp, B.C., for the Upper Arrow Lake. The reservoir volume tables which will be used are for Duncan dated 7 March 1973, for Upper Arrow and Lower Arrow dated 7 March 1973 and for Mica dated 20 February 1967.

(e) Delivery. Requested storage releases will be made effective at the Canadian-United States border. The request will be deemed to have been fulfilled if the total amount of storage water requested in released from Duncan, Arrow and Mica reservoirs, provided an amount equal to or greater than the Duncan storage water release is concurrently discharged past Corra Linn Dam.

(f) Modifications. If any modification to a written request is agreed by the Operating Committee, a further written request superseding the original written request will be dispatched immediately by the U.S. Section of the Operating Committee to the Canadian Section of the Operating Committee.

(g) Non-Routine Operation. Any special operation which is agreed by the Operating Committee will be suitably documented.

(2) Daily Request for Storage Regulation During the Flood Control Season

(a) Forecasts. Day-to-day streamflow forecasts will be accomplished by use of computer simulation by the Columbia River Forecasting Service. The regulation center required by the Flood Control Plan for the flood regulation will be located in the North Pacific Division Office, Corps of Engineers, Portland, Oregon.

(b) Daily Requests for Project Outflows. Pursuant to the operating rules in the Flood Control Plan, the outflows from individual Canadian storage projects are specified on a day-to-day basis. Requests will be coordinated by telephone daily or on an as-needed basis, by conference calls between members of the Operating Committee or their authorized assistants. The requests will normally prescribe the requested outflows as a mean daily discharge in cubic feet per second, for the 24-hour period from noon to noon of each day. Daily requests for project outflows will be documented by message dispatched on the Columbia Basin Teletype Circuit from the regulation center in Portland, Oregon. Acknowledgement of the teletype request will be made by the Canadian authority by teletype message. The project outflows from Canadian projects will be determined by methods as agreed upon for the Hydrometeorological Reporting Network. Any modification of the documented daily request shall be agreed by the Operating Committee before being put into effect, and shall be documented by teletype immediately thereafter.

(3) Regulation During Winter Floods. Daily requests for project outflows from Canadian projects are normally confined to the flood control refill period. During periods of high winter flows in the lower Columbia River, if a special regulation of Arrow storage becomes necessary to preserve the natural flood control storage effect, the outflows from Arrow will be regulated on a day-to-day basis in accordance with the requests of the U.S. Section of the Operating Committee. The requests for such regulation will be in accordance with procedures described above.

7. OPERATING LIMITS

a. Duncan Project

(1) Maximum outflow - 20,000 cfs through outlets.

(2) Minimum average weekly outflow - 100 cfs.

(3) Maximum rate of change in outflow - 4,000 cfs per day.

(4) Normal full pool elevation - 1,892 feet.

(5) Minimum pool elevation - 1,794.2 feet.

b. Arrow Project

(1) Maximum outflow - Physical limits only.

(2) Minimum average weekly outflow - 5,000 cfs.

(3) Maximum rate of change in outflow - 25,000 cfs per day.

(4) Normal full pool elevation - 1,443.5 feet.

(5) Minimum pool elevation - 1,378.0 feet.

(6) Advance notice for changes in outflow for:

(a) Drop in downstream level of:

| | |
|---|---|
| 1/2 foot | None |
| 1 foot | 1 hour |
| 2 feet | 2 hours |
| 3 feet or more | 24 hours |

(b) Rise in downstream level of:

| | |
|---|---|
| 1/2 foot | None |
| 1 foot | 1 hour |
| 2 feet | 2 hours |
| 3 feet | 7 hours - only if notice is received early (before 1000 hours) in the day. Otherwise 24 hour notice is required. |
| More than 3 feet | 24 hours |

Note: Each 5,000 cfs change causes about one foot variation in the downstream level.

c. Mica Project

(1) Minimum average weekly outflow - 3,000 cfs.

NOTE: In order to accelerate the initial filling of Mica Reservoir, and when other conditions permit, the minimum average weekly outflow from Mica project will normally be set at 1,000 cfs during the 1974 filling season.

(2) Operation during 1973-74 will be in accordance with the Program for Initial Filling of Mica Reservoir.

EXHIBIT 1

DETAILED OPERATING PLAN FOR CANADIAN TREATY STORAGE
FIRST CRITICAL RULE CURVE AND ASSURED REFILL CURVE FOR 1973-74

End-Of-Month Usable Storage Content in 1000 SFD

| Month | Critical Rule Curve | | | | Assured Refill Curve 1/ | | | |
|---|---|---|---|---|---|---|---|---|
| | Duncan | Arrow | Mica | Total | Duncan | Arrow | Mica | Total |
| July | 705.8 | 3579.6 | 3230.2 | 7515.6 | 705.8 | 3579.6 | 3230.2 | 7515.6 |
| August | 705.8 | 3408.3 | 3465.4 | 7579.5 | 705.8 | 3408.3 | 3465.4 | 7579.5 |
| September | 645.8 | 3111.7 | 3022.9 | 6780.4 | 645.8 | 3111.7 | 3022.9 | 6780.4 |
| October | 583.8 | 2776.2 | 3000.0 | 6360.0 | 583.8 | 2776.2 | 3000.0 | 6360.0 |
| November | 460.8 | 2284.5 | 2750.1 | 5495.4 | 460.8 | 2284.5 | 2750.1 | 5495.4 |
| December | 171.8 | 1851.7 | 2721.5 | 4745.0 | 223.6 | 1851.7 | 2721.5 | 4796.8 |
| January | 135.8 | 1818.9 | 2072.5 | 4027.2 | 234.8 | 1818.9 | 2072.5 | 4126.2 |
| February | 135.8 | 1948.4 | 1958.5 | 4042.7 | 244.0 | 1948.4 | 1958.5 | 4150.9 |
| March | 120.8 | 1990.7 | 1496.2 | 3607.7 | 258.1 | 1990.7 | 1496.2 | 3745.0 |
| April | 115.8 | 1913.5 | 1111.6 | 3140.9 | 236.5 | 1913.5 | 1111.6 | 3261.6 |
| May | 254.4 | 211.6 | 1123.1 | 1589.1 | 343.8 | 1836.4 | 1123.1 | 3303.3 |
| June | 483.0 | 1124.4 | 1787.9 | 3395.3 | 532.8 | 3331.6 | 2315.9 | 6180.3 |
| July | 630.8 | 375.4 | 2201.8 | 3208.0 | 705.8 | 3579.6 | 3529.2 | 7814.6 |

1/ The Assured Refill Curve indicates the end-of-month storage content required to assure refill of Canadian storage based on 1931 historical volume of inflow for the whole or remaining portion of the refill period. The year 1931 represents the second lowest historical January-July volume inflow for the system as measured at The Dalles, Oregon. The natural volume of inflow at each reservoir is reduced by deducting the Power Discharge Requirement, non-power requirements at site and upstream and water required for refill at upstream reservoirs.

The Power Discharge Requirement for each reservoir is defined in Exhibit 4, assuming 80 maf volume at The Dalles.

EXHIBIT 2

DETAILED OPERATING PLAN FOR COLUMBIA RIVER TREATY STORAGE
SECOND CRITICAL RULE CURVE FOR 1973-74

End-of-Month Usable Storage Content in 1000 SFD

| Month | Duncan | Arrow | Mica | Total |
|---|---|---|---|---|
| July | 351.4 | 438.8 | 1570.0 | 2360.2 |
| August | 251.4 | 191.5 | 1881.8 | 2324.7 |
| September | 151.4 | 94.1 | 1875.2 | 2120.7 |
| October | 51.4 | 293.3 | 1507.1 | 1851.8 |
| November | 0 | 191.7 | 1027.5 | 1219.2 |
| December | 2.5 | 0 | 519.3 | 521.8 |
| January | 0 | 0 | 111.9 | 111.9 |
| February | 0 | 0 | 35.2 | 35.2 |
| March | 0 | 0 | 10.2 | 10.2 |
| April 15 | 0 | 0 | 0 | 0 |
| April 30 | 0 | 0 | 0 | 0 |
| May | 143.3 | 1033.5 | 559.9 | 1736.7 |
| June | 397.7 | 2411.1 | 1816.3 | 4625.1 |

EXHIBIT 3

DETAILED OPERATING PLAN FOR COLUMBIA RIVER TREATY STORAGE
SECOND CRITICAL RULE CURVE FOR 1974-75

END-OF-MONTH USABLE STORAGE CONTENT IN 1000 SFD

| Month | Duncan | Arrow | Mica | Total |
|---|---|---|---|---|
| July | 630.8 | 375.4 | 2201.8 | 3208.0 |
| August | 555.8 | 143.0 | 2454.5 | 3153.3 |
| September | 355.8 | 145.4 | 2399.6 | 2900.8 |
| October | 125.8 | 141.2 | 1985.7 | 2252.7 |
| November | 25.8 | 99.0 | 1462.2 | 1587.0 |
| December | 0.0 | 0.0 | 872.3 | 872.3 |
| January | 0.0 | 0.0 | 373.3 | 373.3 |
| February | 0.0 | 0.0 | 159.5 | 159.5 |
| March | 0.0 | 0.0 | 159.5 | 159.5 |
| April | 0.0 | 0.0 | 129.0 | 129.0 |
| May | 137.5 | 1013.9 | 188.5 | 1339.9 |
| June | 391.9 | 2391.5 | 1444.9 | 4228.3 |

NOTE: The 129,000 second-foot-days remaining in Mica on April 30, 1975, is transferred to dead storage to indicate compliance with the agreement between Bonneville Power Administration and B. C. Hydro whereby B. C. Hydro provided use of 129,000 second-foot-days of storage in Arrow between elevations 1444 and 1446 feet during the 1972-73 Operating Year.

EXHIBIT 4

# DETAILED OPERATING PLAN FOR COLUMBIA RIVER TREATY STORAGE
# 1973-74 FLOOD CONTROL REFILL CURVE
# AND VARIABLE REFILL CURVE PROCEDURES

The Flood Control and Variable Refill Curves indicate the end-of-month storage content required to refill Canadian storage based on forecasts of natural inflow volume. The probable forecast volume at each reservoir is reduced by deducting the 95% confidence forecast error, project discharge requirement, non-power requirements upstream, and water required for refill at upstream reservoirs. Studies made for the U.S. Coordinated System Operation for 1973-74 indicate that the Power Discharge Requirement for all cyclic reservoirs must be greater than project minimum release to allow filling in accordance with the Principles and Procedures coincident with carrying system firm load when The Dalles natural January-July runoff volume is lower than 95 million acre-feet. The following schedule for Power Discharge Requirements will apply for 1973-74:

POWER DISCHARGE REQUIREMENT, CFS,
FOR JANUARY-JULY VOLUME, THE DALLES, OREGON

| | 80 MAF | | | 90 MAF | | | 95 MAF |
|---|---|---|---|---|---|---|---|
| Project | Jan Feb Mar | Apr May Jun | Jul | Jan Feb Mar | Apr May Jun | Jul | All Periods |
| Mica | 3,000 | 11,600 | 14,600 | 3,000 | 6,300 | 8,300 | 1,000 |
| Arrow | 5,000 | 24,200 | 41,000 | 5,000 | 13,200 | 16,000 | 5,000 |
| Duncan | 100 | 1,700 | 1,700 | 100 | 900 | 900 | 100 |
| Libby | 2,000 | 4,200 | 4,200 | 2,000 | 2,300 | 2,300 | 2,000 |

If the forecasted natural volume at The Dalles is less than 80 MAF, the Power Discharge Requirement in the 80 MAF schedule will be used. If the forecasted natural volume at The Dalles is greater than 95 MAF the Power Discharge Requirement will be project minimum release. For intermediate forecasted volumes, the Power Discharge Requirement will be interpolated linearly between the values shown above. The Dalles volume forecast made at the beginning of each applicable month shall be recognized in computing the Variable Refill Curve.

It is recognized that the Canadian Section has the right to make changes to the refill curves for individual projects provided the effect of these changes is consistent with the composite refill curve for Total Canadian storage.

# COLUMBIA RIVER TREATY

## AGREEMENT

on

## DETAILED OPERATING PLAN

## FOR COLUMBIA RIVER TREATY STORAGE

## 1 JULY 1973 THROUGH 31 JULY 1974

The Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage, agreed by the Entities on 25 July 1967, provide that the Entities develop a Detailed Operating Plan for each year's actual operation.

The Canadian Entity and the United States Entity hereby agree that the Treaty storage will be operated in accordance with the attached "Detailed Operating Plan for Columbia River Treaty Storage - 1 July 1973 through 31 July 1974," dated 14 September 1973.

W. D. Kennedy
Chairman
Canadian Entity

Donald Paul Hodel
Chairman
United States Entity

September 28, 1973
Date of Agreement